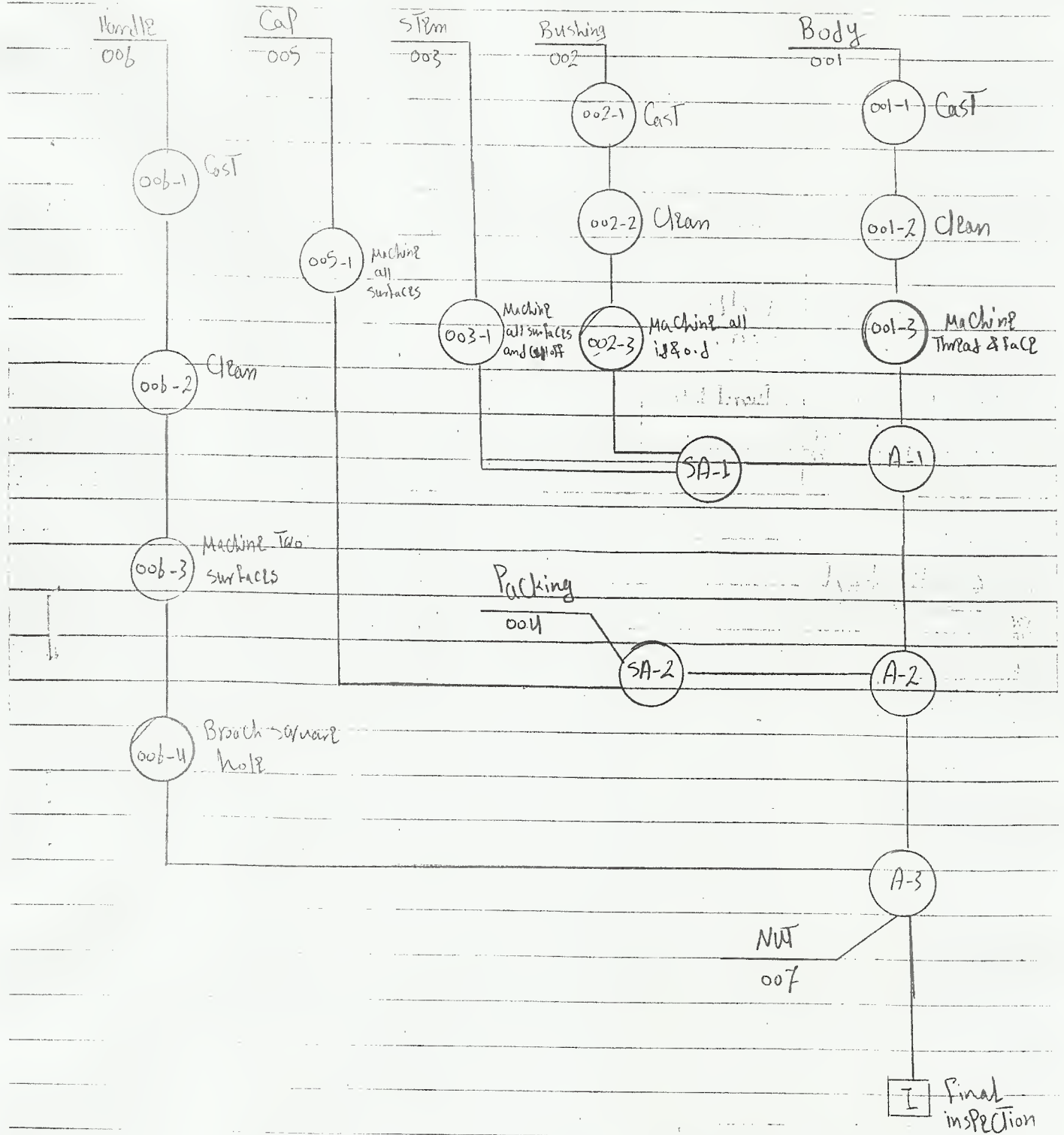


Solution of sheet (2) خاص بالفريق

(1)

2.9 ① Operation Process Chart



2) ROUTE SHEETS

②

Company: EL-SWEEDY

Part Name: Body

Prepared By: ELSOM DRAM

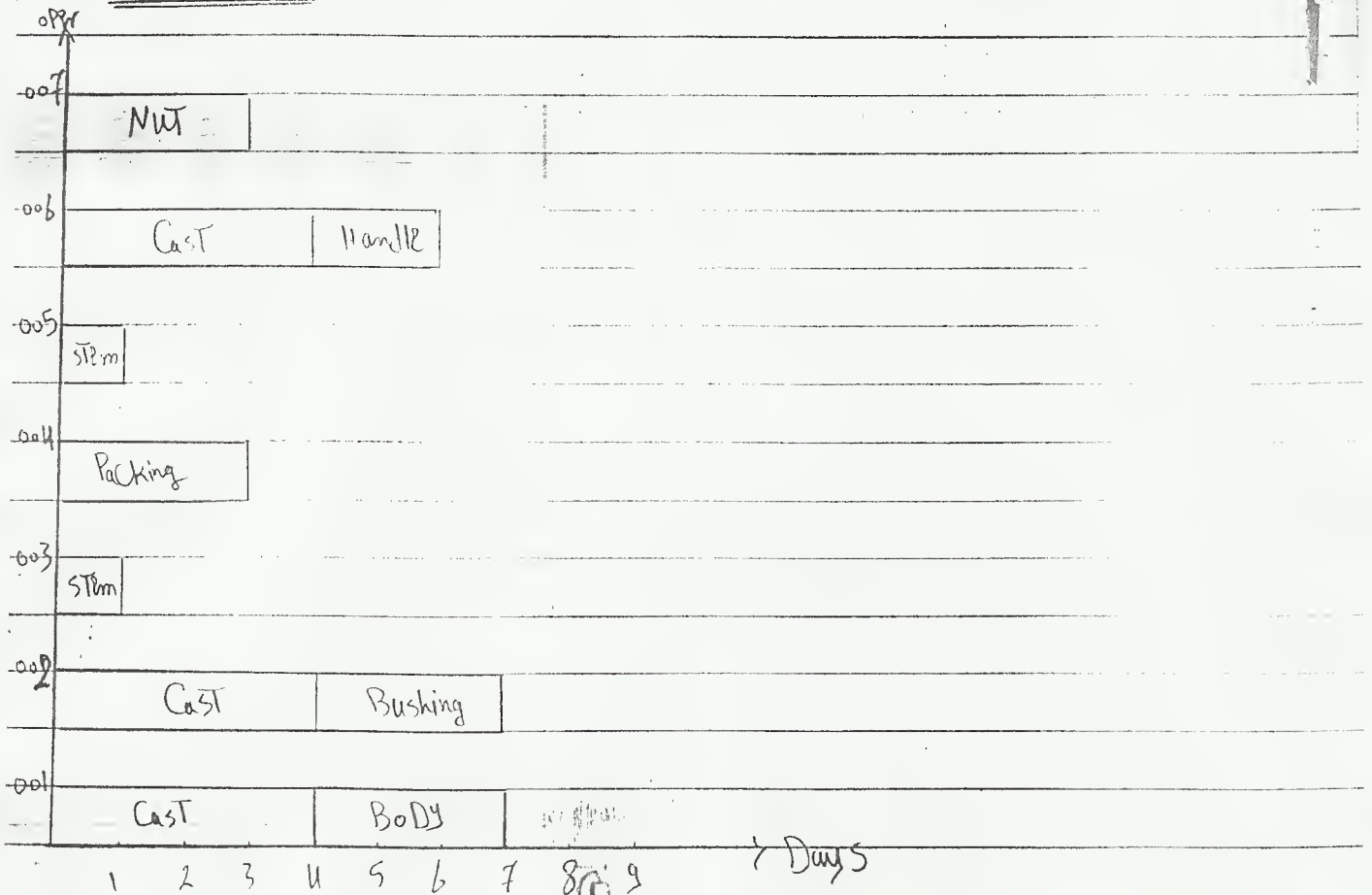
Product: GATE-Valve

Part No: 001

Date: 28/12/2012

OPR. No	OPR description	Machines	Tool	SET UP (hr)	Std. Time (hr)	Materials
001-1	Cast	Bench mold			0.025	Cast Bronze
001-2	Clean	Tumble Barrel			0.006	
001-3	Machine Throat & face three surfaces	Turner lathe			0.011	

3) Gantt Chart



②

(3)

[3] no. of equipment \rightarrow To Produce 500 Gate valves Per hr

$$F = \frac{S \times Q}{H}$$

Brach
mold

H

$$= \frac{3.45 \times 500}{60} = 28.75 = 29 \text{ MC / Min} = 1 \text{ MC / Hr}$$

$$F = \frac{S \times Q}{H}$$

Tumble
barrel

H

$$= \frac{0.9 \times 500}{60} = 7.5 = 8 \text{ MC / Min} = 1 \text{ MC / Hr}$$

$$F = \frac{S \times Q}{H}$$

Turret
Lathe

H

$$= \frac{4.15 \times 500}{60} = 35 \text{ MC / Min} = 1 \text{ MC / Hr}$$

$$F = \frac{S \times Q}{H}$$

Automatic
screw MC

H

$$= \frac{0.42 \times 500}{60} = 1 \text{ MC / Hr}$$

$$F = \frac{S \times Q}{H}$$

Broach

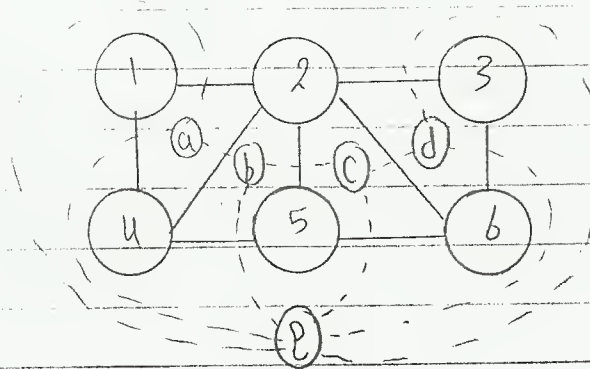
H

$$= \frac{0.15 \times 500}{60} = 1 \text{ MC / hr}$$

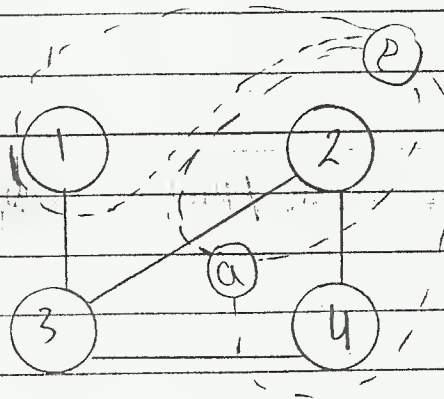


2.11

(u)



2 is EXTERIOR



3 is EXTERIOR

(4)

2.12 Are two graph equivalent? Justify your answer?

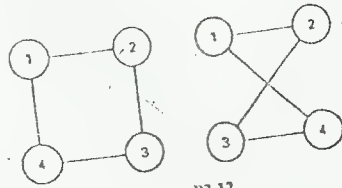
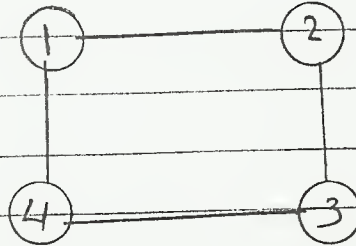
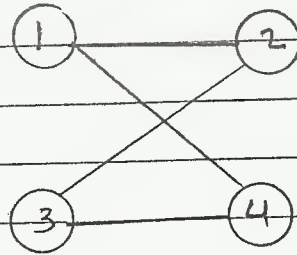
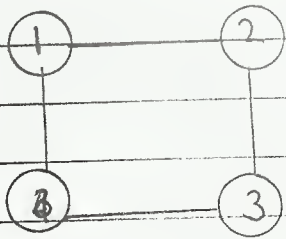


Figure P2.12



two graphs are equivalent.

④ ⑤

2.15. Is the graph shown in Figure P2.15 planar? If so, construct the dual graph and the corresponding block layout.

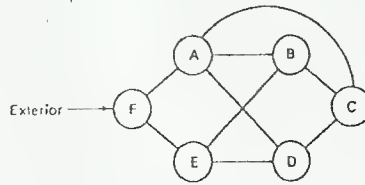
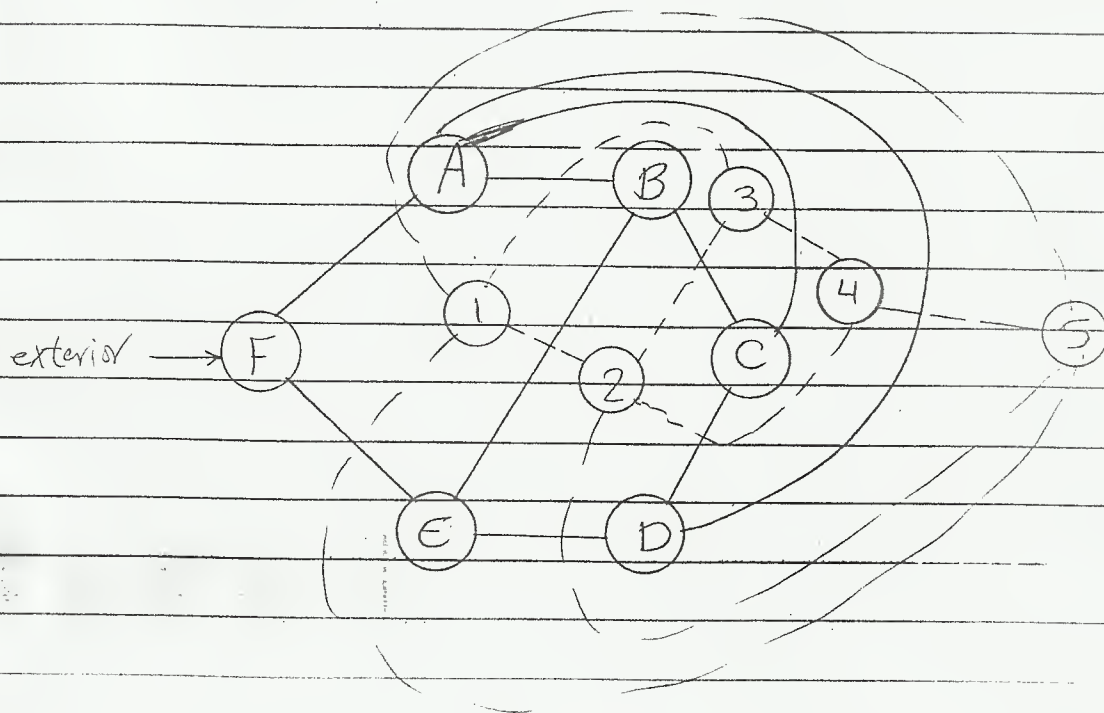


Figure P2.15



A, B, C, D, E planar
1, 2, 3, 4, 5 dual
F exterior

10 7

(5)

2.13

First shape is non-planar Because There aren't any intersection

Second shape is non-planar Because The intersection

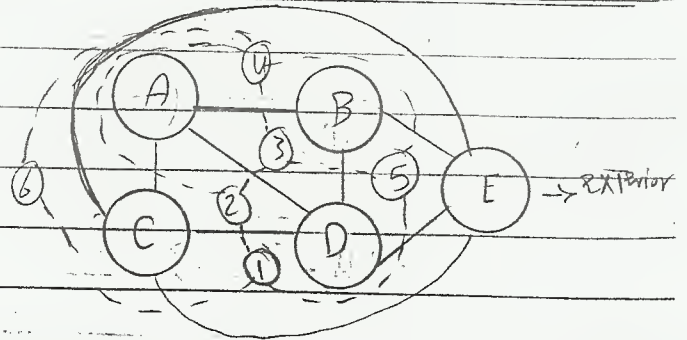
2.14

Assumption
 $A \Rightarrow AB, AD$
 $E \Rightarrow AC, BD, BC$
 $I \Rightarrow CD$, $U \Rightarrow AE, BE, CE, DE$

① Assumption on (REL) Diagram

② Solve it By (SLP) method

③ Solve it By graph method



2.26

Power shovels

truck

 $b = 0$ $a = 10$ $t = 15 + 2 + 12 = 29$

$$n' = \frac{a+t}{a+b} = \frac{39}{10} = 3.9 = 4$$

$$C_0 = 125$$

$$C_m = 75$$

$$E = \frac{C_0}{C_m} = \frac{5}{3}$$

$$\Phi = \frac{E+n}{E \cdot n+1} \times \frac{n'}{n} = \frac{\frac{5}{3}+3}{\frac{5}{3}+4} \times \frac{3.9}{3} = 1.07 \approx 2 \text{ M/Cs}$$

(8)

(b)

2.28

$$I_0 = 10 \text{ minutes} \Rightarrow 3 \text{ M/Cs}$$

$$t = 25 \text{ Min}, b = 1 \text{ min}$$

$$T_c = (a+t)$$

$$\therefore I_0 = T_c - (a+b)m$$

$$\therefore 10 = 25 + a - 3a - 3$$

$$\therefore 2a = 12$$

$$\therefore a = 6 \text{ Min}$$

$$\therefore n' = \frac{a+t}{a+b} = \frac{31}{7} = 4.4 \approx 5 \text{ M/Cs}$$

$$T_c = (C_0 + mC_m)(a+b)$$

$$= (8 + 3 \times 25)(7) = \$ 1141$$

$$\therefore \phi = \frac{C + n}{C + (n+1)} \times \frac{n'}{n}$$

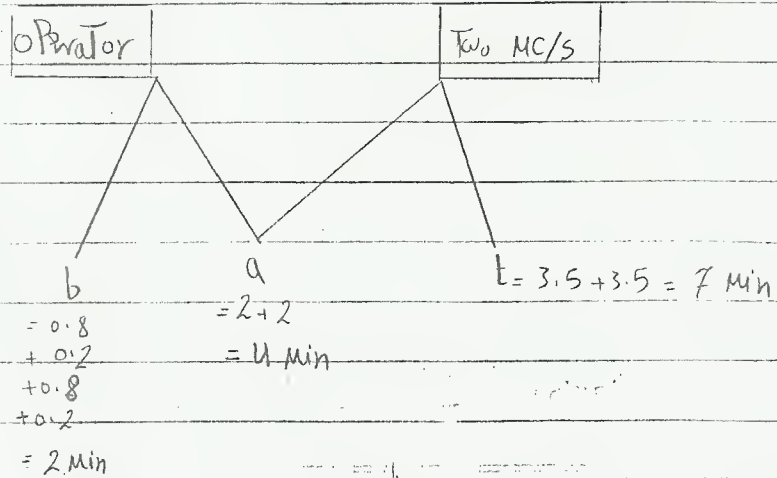
$$= \frac{0.32 + 4}{0.32 + 5} \times \frac{4.8}{5} = 0.77$$

$$\therefore \phi < 1 \quad \therefore m' = n = 4 \text{ M/Cs}$$

(9)

(7)

2.29



$$\eta = \frac{a+t}{a+b} = \frac{11}{6} = 1.8 \sim \begin{matrix} \nearrow 1 \text{ MC/s} \\ \searrow 2 \text{ MC/s} \end{matrix}$$

$$\therefore \text{Total Cost} = (C_0 + m C_m) \left(\frac{a+t}{m} \right)$$

$$= (15 + 2 \times 30) (11) = 825 +$$

$$\therefore I_0 = (a+t) - (a+b)m$$

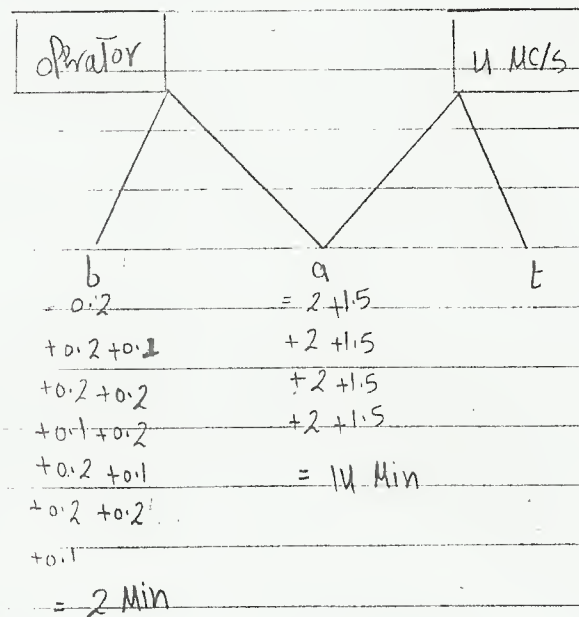
$$I_0 = 11 - 6 \times 1 = 5$$

$$\text{if } \eta = 2$$

$$\therefore I_0 = 11 - 12 = -1$$

$$\therefore \text{Optimum } m = 1$$

2.31



$$\therefore I_{m=10} = (a+b)m - (a+t) \Rightarrow I_0 = (16 \times 11) - 11 - t$$

$$\therefore t = 110 \text{ Min}$$

(10)

(8)

$$n' = \frac{a+t}{a+b} = \frac{54}{16} = 3.3 \sim 4 \text{ MC/s}$$

$$\phi = \frac{0.5+3}{0.5+4} \times \frac{3.3}{3} = 0.85$$

$$\phi < 1 \quad \therefore m' = n = 3 \text{ m/cs}$$

$$\textcircled{b} \quad m = 2 \text{ MC/s} < n'$$

$$\therefore T_c = (C_0 + mC_m) (a+1)/m$$

$$= (15 + 2 \times 30) \left(\frac{54}{2} \right) = \$ 2025$$

[2.32]

22

SUPPLY

Truck

حل ال 5 فور
Face 6

$$b=0$$

$$a$$

$$= 10$$

$$t = 30 + 30 + 20 = 80$$

$$\therefore n' = \frac{a+t}{a+b} = \frac{90}{10} = 9 \text{ MC/s}$$

Laborers

wheelbarrows

$$b=0$$

$$a$$

$$= 0.5 + 3$$

$$+ 1$$

$$= 4 \text{ Min}$$

$$t = 1 \text{ Min}$$

$$\therefore n' = \frac{a+t}{a+b} = \frac{5}{4} = 1.25 \approx 2 \text{ laborer}$$

(11)

(10)

تكملة رقم 3b

Case 2 \Rightarrow (5,6)

$$TC = TC(m=5) + TC(m=6)$$

$$= [(C_0 + m(m)(a+b))] + [(C_0 + m(m)(a+b))]$$

$$= [(15 + 5 \times 50) \left(\frac{9.5}{60} \right)] + [(15 + 6 \times 50) \left(\frac{9.5}{60} \right)]$$

$$= \$ 91.833$$

Case 3 \Rightarrow (4,4,3)

$$TC = 2[TC(m=4)] + [TC(m=3)]$$

$$= 2 \left[(15 + 4 \times 50) \left(\frac{9.5}{60} \right) \right] + \left[(15 + 3 \times 50) \left(\frac{9.5}{60} \right) \right]$$

$$= \$ 49.875$$

select Case (3)

$$\textcircled{C} \quad \phi = 1 \quad \Rightarrow \quad E = ??$$

$$\therefore 1 = \frac{E + 1}{E + n + 1} \times \frac{n}{n}$$

$$\therefore 1 = \frac{E + 2}{E + 3} \times \frac{2.9}{2}$$

$$\therefore \frac{20}{29} = \frac{E + 2}{E + 3} \quad \Rightarrow \quad 20E + 60 = 29E + 58$$

$$\therefore E = \frac{2}{9} = 0.222$$

12

(9)

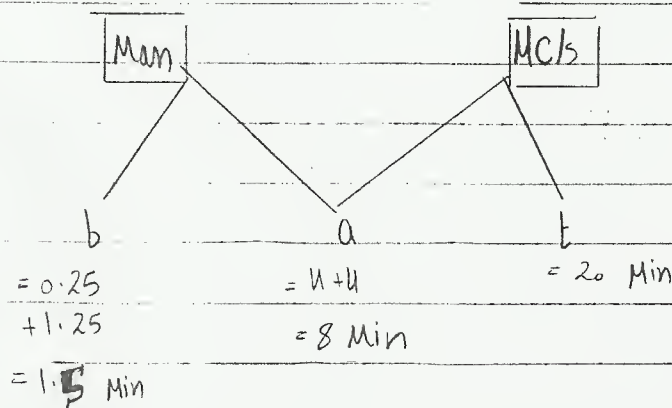
$$\textcircled{b} I_m = (a+b)m - (a+t)$$

$$= (4 \times 2) - 5 = 3 \text{ Min}$$

$$\textcircled{c} T_c = (a+b)m$$

$$= 4 \times 2 = 8 \text{ times}$$

2.36



$$\textcircled{a} n' = \frac{a+t}{a+b} = 2.9 \approx 3 \text{ M/Cs}$$

$$\textcircled{b} \text{ Case 1} \Rightarrow (3, 3, 3, 2)$$

$$T_c = 3 [T_c(m=3)] + [T_c(m=2)]$$

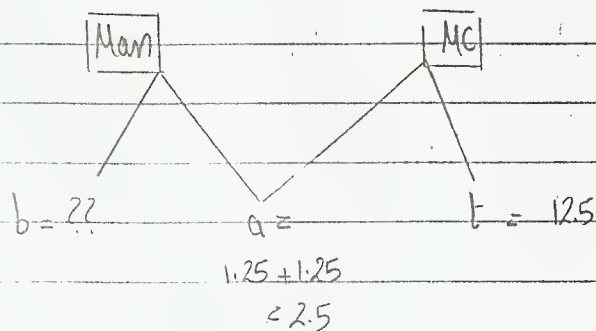
$$= 3 \left[(C_0 + mC_m)(a+b) \right] + \left[(C_0 + mC_m) \left(\frac{a+t}{m} \right) \right]$$

$$= 3 \left[(15 + 3 \times 50) \left(\frac{9.5}{60} \right) \right] + \left[(15 + 2 \times 50) \left(\frac{28}{60} \right) \right]$$

$$= \$ 132.04$$

(13)

2.38



$$\eta = \frac{a+t}{a+b}$$

$$\text{Utilization} = \frac{\text{Cycle time} - \text{idle time}}{\text{Cycle time}}$$

$$= \frac{(a+t) - [(a+t) - (a+b)m]}{(a+t)}$$

$$\therefore 0.8 = \frac{(a+b)m}{(a+t)}$$

$$\therefore 0.8 = \frac{(2.5+b)4}{15}$$

$$\therefore b = 0.5 \text{ Min}$$

$$\text{a) } \therefore \eta = \frac{15}{3} = 5 \text{ M/c}_s$$

(b)

 η

$$4 < \eta < 5$$

$$5 < \eta < 6$$

$$\phi = \frac{\frac{C_0}{C_m} + n}{\frac{C_0}{C_m} + n+1} \times \frac{\eta}{n} > 1$$

$$\frac{0.25+5}{0.25+b} \times \frac{\eta}{5} < 1$$

$$\frac{0.25+4}{0.25+5} \times \frac{\eta}{4} > 1$$

$$\therefore \eta < 5.95$$

$$\therefore \eta > 4.94$$

(14)

(11)

$$\frac{15}{2.5+b} > 4.94$$

$$\therefore 4.94b + 12.35 < 15$$

$$\therefore b < 0.54$$

$$\frac{15}{2.5+b} < 5.95$$

$$14.875 + 5.95b > 15$$

$$\therefore b > 0.02$$

$$\therefore \text{Range of } b \Rightarrow 0.02 \leq b \leq 0.54$$

(C) 18 M/C

$$\text{Case 1} \Rightarrow 5, 5, 5, 3$$

$$\text{Total Cost} = 3 T_c(n=5) + T_c(n=3)$$

$$= 3 \left[(C_0 + mC_m) \left(\frac{a+t}{m} \right) \right] + \left[(C_0 + mC_m) \left(\frac{a+t}{m} \right) \right]$$

$$= 3 \left[(10 + 200) \left(\frac{15}{b \times 5} \right) \right] + \left[(10 + 120) \left(\frac{15}{b \times 3} \right) \right]$$

$$= \$ 41.8$$

$$\text{Case 2} \Rightarrow b, b, b$$

$$\text{Total Cost} = 3 T_c(n=b)$$

$$= 3 \left[(C_0 + mC_m) (a+b) \right]$$

$$= 3 \left[(10 + 240) \left(\frac{3}{b_0} \right) \right] = \$ 37.5$$

\therefore Select Case 2

(15)

(12)

2.39

$$m = 3 \text{ M/Cs}$$

$$C_0 = 10 \$$$

$$\text{Utilization} = 0.78$$

$$C_m = \$ 12$$

$$a = 8 \text{ Min}$$

$$b = 5 \text{ min}$$

$$\text{Utilization} =$$

$$\frac{\text{Cycle time} - \text{idle time}}{\text{Cycle time}}$$

$$= \frac{(a+t) - [(a+t) - (a+b)m]}{a+t}$$

$$\therefore 0.78 = \frac{(a+b)m}{a+t}$$

$$\therefore 0.78 = \frac{13 \times 3}{8+t}$$

$$\therefore 6.24 + 0.78t = 39$$

$$\therefore t = 5.25$$

$$\therefore n' = \frac{a+t}{a+b} = 1.01 \sim 2 \text{ M/Cs}$$

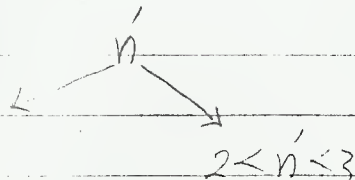
$$\Phi = \frac{\frac{C_0}{C_m} + n}{\frac{C_0}{C_m} + n+1} \times \frac{n'}{n}$$

$$= 0.65$$

$$\textcircled{a} T_c = (C_0 + mC_m) \left(\frac{a+t}{m} \right)$$

$$\therefore n' \geq n \geq 1 \text{ M/Cs}$$

$$= (10 + 3 \times 12) \left(\frac{13.25}{1} \right) = \$ 609.5$$



$$\Phi \geq 1 \quad \frac{\frac{C_0}{C_m} + n}{\frac{C_0}{C_m} + n+1} \times \frac{n'}{n} \geq 1$$

$$\frac{\frac{5}{b} + 2}{\frac{5}{b} + 3} \times \frac{n'}{2} < 1$$

$$\frac{\frac{5}{b} + 1}{\frac{5}{b} + 2} \times \frac{n'}{1} \geq 1$$

$$\therefore n' < 2.7$$

$$\therefore n' > 1.545$$

(16)

(13)

$$\frac{a+b}{a+b} > 1.545$$

$$\frac{a+b}{a+b} < 2.7$$

$$\frac{a+5.25}{a+5} > 1.545$$

$$\frac{a+5.25}{a+8} < 2.7$$

$$\therefore a+5.25 > 1.545a + 7.725$$

$$a+5.25 < 2.7a + 21.6$$

$$\therefore -0.545a > 2.475$$

$$\therefore -1.7a < 16.95$$

$$\therefore a < -4.5$$

$$\therefore a > -9.95$$

NOTES:

نکات مهم

(17)

(14)

2.33

$$m = 3 \text{ MC}$$

$$I_0 = 10 \text{ Min}$$

$$t = 25 \text{ Min}$$

$$b = 1 \text{ min}$$

$$C_0 = \$4$$

$$C_m = \$6$$

$$(a) \quad I_0 = T_c - (a+b)m$$

$$\therefore I_0 = (a+t) - am - bm$$

$$\therefore I_0 = a + 25 - 3a - 3$$

$$\therefore 2a = 12$$

$$\therefore a = 6 \text{ Min}$$

$$\therefore n' = \frac{a+t}{a+b} = \frac{31}{7} = 4.428 \approx 5 \text{ MC/s}$$

$$\Phi = \frac{C_0}{C_m + n} \times \frac{n}{n}$$

$$= \frac{C_0}{C_m} \times \frac{n+1}{n}$$

$$= 0.9$$

$$\therefore n = 4$$

$$(b) \quad T_c = (C_0 + mC_m) \left(\frac{a+t}{m} \right)$$

$$= (4 + 3 \times 6) \left(\frac{31}{3} \right) = \$217 \text{ Per hr}$$

$$(c) \quad C_0 \text{ s? } 1 \Rightarrow 3, 3, 3$$

$$\therefore T_c = 3 [T_c (n=3)]$$

$$= 3 \left[(C_0 + mC_m) \left(\frac{a+t}{m} \right) \right]$$

$$= 3 \left[(4 + 3 \times 6) \left(\frac{31}{3 \times 60} \right) \right]$$

$$= \$11.36$$

(18)

(15)

Case 2 \Rightarrow 4.5

$$\bar{T}_c = [\bar{T}_c (n=4)] + [\bar{T}_c (n=5)]$$

$$= \left[(C_0 + m(C_m)) \left(\frac{a+b}{m} \right) \right] + \left[(C_0 + m(C_m)) (a+b) \right]$$

$$= \left[(1 + 4 \times 6) \left(\frac{31}{4 \times 60} \right) \right] + \left[(1 + 4 \times 6) \left(\frac{7}{60} \right) \right]$$

$$= \$ 6.88$$

 \therefore select Case [2]

(19)

2.40. The KLM Job Shop has requested that a new layout be designed for their operation in Alpharetta, Georgia. There are 12 departments involved. The department areas (in square feet) and activity relationships for the job shop are summarized in Figure P2.40. Design a block layout using the SLP approach.

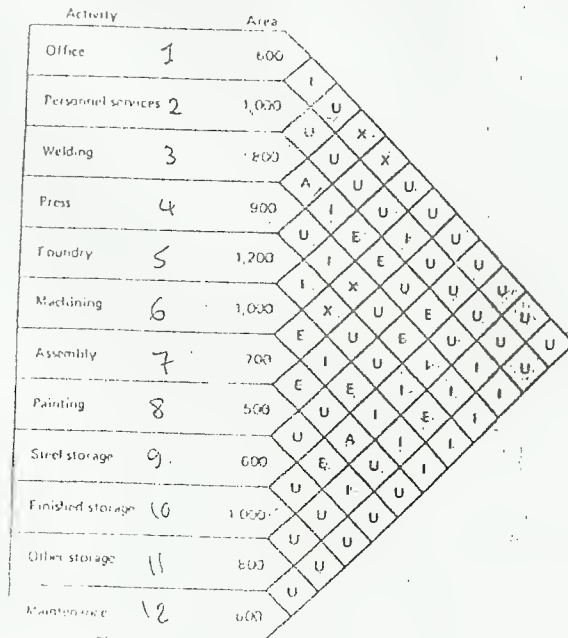


Figure P2.40

1- Solving by TCR:

	^{10,000} A	^{1,000} E	¹⁰⁰ I	¹⁰ O	⁰ U	^{-100,000} X	TCR	Ranking
1			1		8	2	-199,900	12
2			1		10		100	8
3	1	3	3		4		13,300	1
4	1		4		4	2	-189,600	10
5		1	4		4	2	-198,600	11
6		3	6		2		3,600	4
7	1	3	1		4	2	-186,900	9
8		2	2		7		2,200	6
9		3			8		3,000	5
10	1	1	3		6		11,300	2
11	1		4		6		10,400	3
12			4		7		400	7

6

80

m/c selected

3 4 9 6 11 5 12 10 8 2 7 1

~~1 U X U U U X U U U I U~~

~~2 U U U U U U U U U~~

~~4 A~~

~~5 I U U I E~~

~~6 E I E~~

~~7 E X U U U X U A E I~~

~~8 U U U U I U U E~~

~~9 E E~~

~~10 U I U U U I U~~

~~11 I I U U~~

~~12 I I U U U I~~

not selected
m/c

7			11	5
2	10	4	3	12
1	8	9	6	

(21) (7)

17

2.11

(a) From To Chart

To From	A	B	C	D	E	F
A		800+1000 +600+200 +1100+200 +250+1800 11100	1500	0	0	0
B	0		800+1000 +2000+2000 +1100+2500+800 9500	2000+2500 +1000	1000+600 +2500	2000+2500
C	0	1000+2000 +2500 5500		800+1100 +800	2000+1500	1000+2000
D	0	2500	1000		800+1100 +2000+1100	800
E	0	2500	1000			800
F	0	2500+2000 4500	2000	1000	800+600 +1500+1100 +1000 4300	

Rel Chart

A	E	A	E	I	I	I
B	11100	1500	0	0	0	0
C	15000	8000	0	0	0	0
D	3000	8000	0	0	0	0
E	5200	5500	0	0	0	0
F	4300	800	3000	0	0	0

ACI:

$\textcircled{=}$ A \Rightarrow BC

$\textcircled{=}$ E \Rightarrow AB, BD, BE

$\textcircled{=}$ I \Rightarrow BF, CE, DE, EF

$\textcircled{-}$ 0 \Rightarrow AC, CD, CF, DE

22

- 2.14. The graph-based approach for constructing REL diagrams depends on having some department adjacent to the exterior. Suppose that it is not necessary for any department to be adjacent to the exterior. Propose some reasonable approaches that will allow use of the graph-based approach.

- 2.44. An auto-parts warehouse in Flyspeck, Texas, has requested that a new layout be designed for their main warehouse located in metropolitan Flyspeck. The warehouse has 10 major activity "centers." The current building has the dimensions of 150 ft \times 225 ft. Other pertinent data are summarized in Figure P2.44. Using SLP, design a layout to be contained in the current building.

Activity		Area
Office	1	1,250
Counter	2	2,500
Parts bins	3	10,000
Muffler bins	4	2,500
Tape racks	5	6,250
Paint room	6	3,000
Storage	7	5,000
Receiving	8	2,500
Lounge	9	500
Rest room	10	250

Figure P2.44

$$A: 3-2, 8-7$$

$$E: 1-2, 3-4, 5-4$$

$$I: 1-9, 9-2, 5-2, 4-2, 9-3, 5-3, 6-4, 6-5$$

$$O: 10-1, 10-3, 6-2, 10-3, 7-3, 6-3, 10-4, 9-4, 7-4, 10-5, 9-5, 7-5, 10-6, 9-6, 7-6, 10-7, 9-7, 10-8, 9-8, 10-9$$

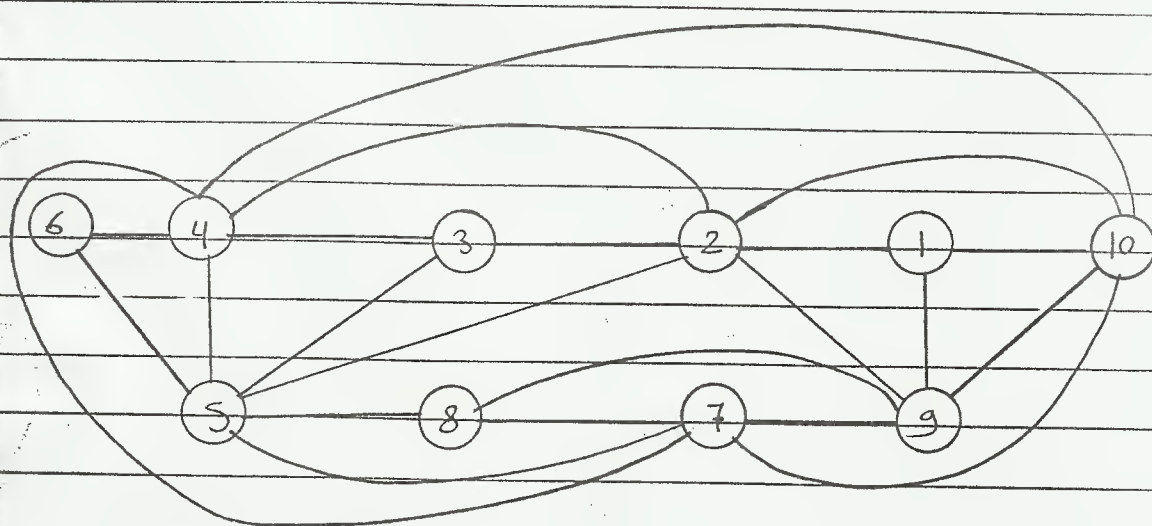
$$U: 8-1, 7-1, 6-1, 5-1, 4-1, 3-1, 8-3, 8-4, 8-5, 8-6$$

$$X: 8-2, 7-2$$

(11)

(24)

2/1/ Solving by graph method:-



12

25

244:

$\equiv A: 3-2, 8-7$

$\equiv E: 1-2, 3-4, 5-4$

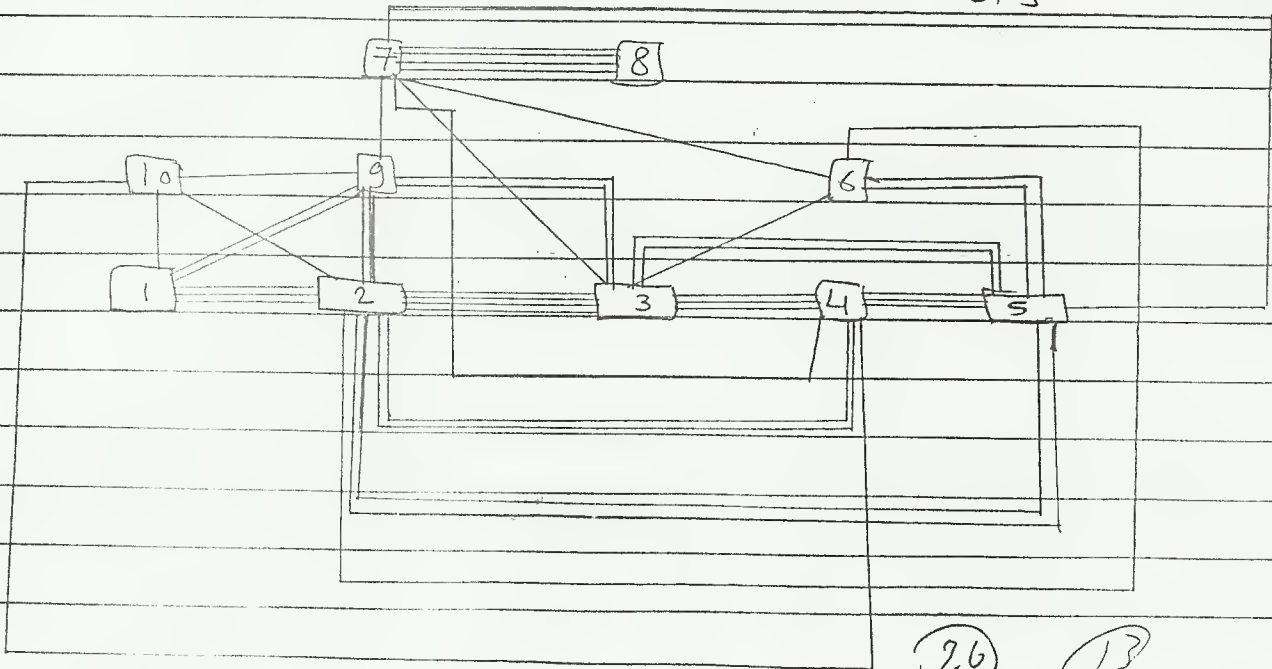
$\equiv T: 1-9, 9-2, 5-2, 4-2, 9-3, 5-3, 6-4, 6-5$

$-O: 10-1, 10-2, 10-3, 6-2, 7-3, 6-3, 10-4, 9-4, 7-4, 10-5, 9-5, 7-5, 10-6, 9-6, 7-6, 10-7, 9-7, 10-8, 9-8, 10-9$

$U: 8-1, 7-1, 8-1, 5-1, 4-1, 3-1, 8-3, 8-4, 8-5, 8-6$

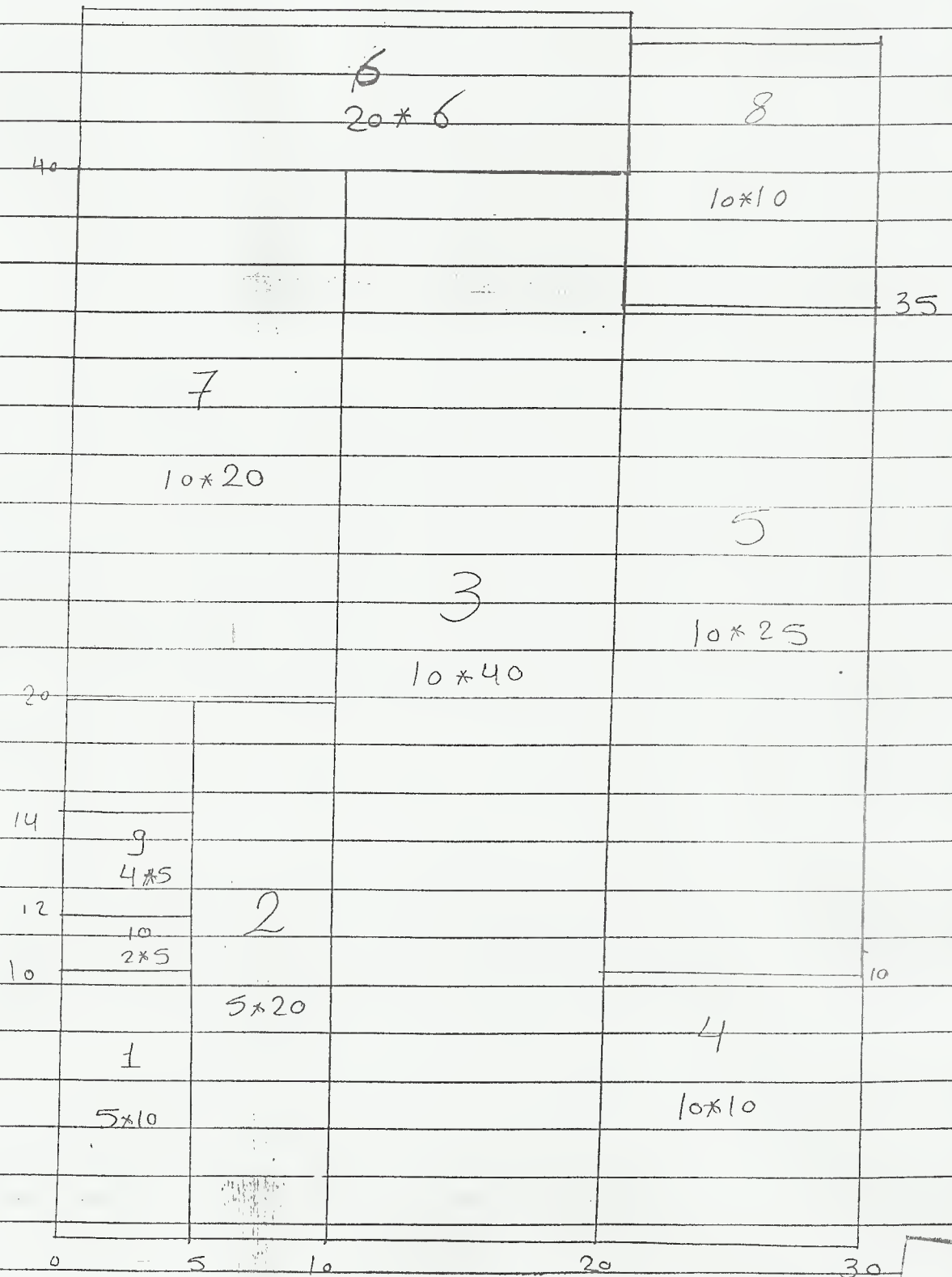
$X: 8-2, 7-2$

	1	2	3	4	5	6	7	8	9	10
	1250	2500	10000	2500	6250	3000	5000	2500	500	250
25 ÷	50	100	400	100	250	120	200	100	20	10
	5x10	5x70	10x40	10x10	10x25	20x6	10x20	10x10	4x5	2x5



(26)

(13)



(14)

(27)